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RESISTORS, FIXED FILM TYPE

GENERAL PURPOSE

QUARTERLY PROGRESS REPORT #12

1 April 1962 through 30 June 1962

CONTRACT NO. DA-36-039-SC-81283

ORDER NO. 7630-PP-59-81-81

Prepared for the U. S. Army Signal Agency

by

RESEARCH AND DEVELOPMENT DIVISION

INTERNATIONAL RESISTANCE COMPANY


ASTIA

FEB 15 1963

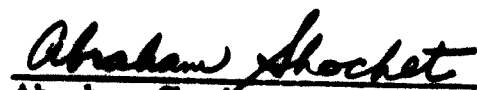
RESTORS, FIXED FILM TYPE
GENERAL PURPOSE
QUARTERLY PROGRESS REPORT #12
1 April 1962 through 30 June 1962

Contract No.: DA-36-009-SC-81283
Order No.: 7630-PP-59-81-81
Applicable Specifications: SCS-22A
Report Prepared at: International Resistance Co.
401 North Broad Street
Philadelphia 8, Pa.

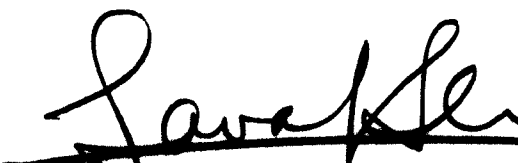
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ABSTRACT

All RC-07 pre-production testing has been completed except for the 400 Group III tests which had to be repeated due to a test equipment failure.

Performance data from RC-07, .29 megohm and RC-20, .20 megohm resistors is presented for informational purposes.

Mechanism of failure studies have identified two modes of failure: (1) damaged resistive film, and (2) imperfect C. P. termination beads. A 100% noise and tensile pull test is planned to eliminate such failures on pilot run testing.

All reliability testing has been completed except for 100°C. Load Life and 175°C. No Load.

In order to meet the failure rate goal of .1%, some efficient non-destructive screening test will have to be developed. To this end, a 96 hour load life "burn-in" screening test was tried but had to be discarded when the results proved unsatisfactory.

BACKGROUND

The purpose of this contract is to establish a production facility with capacity necessary to manufacture a minimum of 35,000 each of 1/4 watt (RC-07) and 1/2 watt (RC-20) resistors per eight (8) hour shift.

The resistors are to have the performance characteristics as set forth in SCS-22A (dated 15 January 1959) as modified by this contract. In addition to other performance tests, the resistors must pass (1) a moisture resistance (10 cycles) test with a performance goal of $\pm 3.0\%$ and (2) a load-life test at 100°C for 2000 hours with a performance goal not to exceed 6% for individual units while the average of the group is not to exceed 3%.

As defined in the contract, the desired maximum failure rate of these resistors shall not be greater than one in one thousand (1 in 1000). The failure rate shall be ascertained during the reliability evaluation and the Pilot Run.

During the period between September 15, 1958 to July 8, 1959, process development work was continued by IRC in an effort to improve the performance characteristics and reliability of the High Stability Resistor beyond the level which was attained at the conclusion of Contract DA-36-039-SC-73235. This work was performed at IRC expense, and

improvements were made in the following areas:

- (1) overcoat materials development for improved moisture resistance.
- (2) contact paint development for improved performance of unspiralled, intermediate range (300 ohm to 0.25 megohm) resistors.
- (3) establishment of processing conditions (specifically arccspiralling parameters) for improvement of short-time overload performance.

Development work was continued at IRC expense on the high-range (above 10 megohm) resistor process.

One of the objectives of this contract is to provide a "high stability," mass-produced resistor at a cost approximately equal to that of the carbon composition resistor. To accomplish this, it will be necessary to set up a highly mechanized operation with a minimum of hand and/or transfer operations. This has already been accomplished with the IRC type BT resistor and will serve as a guide for the contract work.

Resistor element development is being done in three areas: low, intermediate, and high range.

I. Product and Process Development

No activity during this quarter.

II. Pre-Production Testing - RC-07 and RC-20

RC-07 pre-production test results, except shelf life, for ranges (40Ω, 0.29 megohm, and 0.45 megohm) are summarized in Tables I through III. This completes the last of the RC-07 ranges tested under Phase I, pre-production. RC-20 performance results for the .20 megohm range are shown in Table IV.

RC-07 40Ω

Failures were obtained on dielectric wet (2), and moisture cycle, Load (5).

The dielectric failures were due to pin holes in the mold jacket. Units processed under phase II, Pilot Plant will be visually inspected more closely to eliminate this condition.

During the moisture cycle test, a mechanical failure occurred, resulting in the overloading of the units on load. These units showed maximum changes from 6.0 to 7.0%. As a result of the momentary overloading of the circuit in which all units were connected in parallel, above normal % ΔR's were obtained. The mechanical failure resulted from a *"Blue M" power

*Manufactured by the Amphenol-Borg Electronic Corp., Broadview, Ill.
Part Number 26-190-32.

connector which shorted and accidentally subjected the resistors on load to an overload at 100 volts. These resistors normally are loaded at 3.2 volts. As a results of this accidental overloading, an additional (40) units have been put through the moisture cycle test sequence. As yet, results are not available.

RC-07 - 0.29 megohm

There was (1) failure on low temperature operation, (1) on moisture resistance, (1) on Short Time overload, and (1) on 100° Load Life. In all cases there were no open units.

The 0.29 megohm test results are presented for information purposes only and have no bearing on pre-production test phase approval.

On removing the mold jacket and overcoat from the moisture resistance failure (4.47%) and examining it under a 33x scope, nothing significant was observed.

The low temperature operation failure (1.94%) was due to termination, a crack in the Cp bead. A 100% noise and pull test should eliminate such failures on pilot run testing.

The short time overload (unstable) and 100° load life (6.65%) units were accidentally broken on attempting to remove the mold jacket and overcoat.

In all likelihood, the unstable unit was also due to a weak termination.

RC-07 - 0.45 megohm

Two (2) failures were obtained on moisture cycle. The two moisture cycle failures (5.47% and 5.14%) were examined under a scope and nothing significant was seen. A total of two failures is permitted for this test group.

RC-20 - 0.20 megohm

Performance results for the last of the RC-20 ranges (0.2 megohm) are presented in Table IV. There was (1) failure on moisture load, (8) on 100° load life, (1) on solder and (3) on 70° load life.

Mechanism of failure investigations reveal the following:

- (a) Moisture cycle (4.37%) and solder (6.31%) failed units broke on removing mold jacket and overcoat, thus preventing any meaningful investigation and mechanism of failure conclusions.
- (b) 70° Load Life - (3) open failures. Hair line fissures were observed running across the conductive path on two of the units. The third unit showed nothing significant. It is hoped that the use of a noise screening test will sort out similar potential failures prior to pilot run testing.
- (c) 100° Load Life - (1) open, 7% ΔR failures and average % ΔR lot failure (3.12%). The individual and lot failures were due to

using too high a base range. Lower base ranges will be used in pilot plant operations.

III. Reliability Evaluation

The contract specifies that reliability testing was to be conducted on a sample of (20) resistors per environment. However, since this sample size was considered too small to ascertain with any meaningful confidence the failure rate of the unit, additional samples of (2) each for RC-20 ranges (38 ohm, 2800 ohm, 0.24 megohm, 0.48 megohm) and RC-07 ranges (24 ohm, 3000 ohm, 0.27 megohm and 0.48 megohm) were submitted to test.

The tests were continued until either:

- (a) 100% of the sample had failed, (the contract required 50%), or
- (b) The test cycle on time was exceeded by a factor of 10, or (1) year of test time had elapsed.

A summary of the data by average maximum, minimum and number of failures by test cycle or hours is shown in Tables V through XIII. Except for two tests, 100° Load Life and 175° No Load, all tests have been completed.

One reliability objective of the contract was to develop a resistor having no greater than a 1 in 1000 (0.1%) failure rate with 80% confidence when subjected to specified stress environments of Table XIV. An example of the calculations used to arrive at the failure rate observed from the

reliability test phase is carried out below.

Taking the low temperature storage data in Table V with a failure designated as anything beyond $\pm 1.0\% \Delta R$, we obtain on grouping all ranges and both styles, zero (0) failures out of (160) units for the normal or first test cycle. (Failure rate calculations in all cases were based on data collected on the first cycle or first 2000 hours).

(1) Observed failure rate $0/160 \times 100 = 0.0\%$.

On using the Poisson⁽¹⁾ probability distribution for calculating the upper one-sided 80% confidence limit with zero (0) failures and a sample size of (160) we find,

(2) One-sided upper 80% confidence limit = 1.01%.

Dividing 1.01% by the assigned weighting on severity ratio of 100, we obtain:

(3) $1.01\%/100 = 0.01\%$

as the failure rate for low temperature exposure.

Identical calculations were carried out for all other tests except high temperature exposure, 175° No Load. See Table XIV for results. The 175° No Load data was eliminated from the failure rate calculations

(1) Note: Values were taken from Miss F. Thorndike's chart showing cumulative probability curves for the Poisson distribution. (Bell System Technical Journal, October, 1926).

due to the obvious inability of the unit to withstand this environment for the time specified. With the 175° high temperature exposure test omitted, the overall target failure rate goal becomes 0.086%.

The observed failure rates, with 80% confidence for moisture cycle (0.15%) and load life (0.045%) exceeded the failure rate goal of 0.004% and the overall failure rate of (0.21%) exceeded the goal of 0.086% per test cycle and 1000 hours.

IV. Screening Tests

In order to meet the failure rate goal of 0.1%, some efficient non-destructive screening tests will have to be developed. A number of screening tests are now under consideration such as noise, X-ray, 100% pull test and twist test (check for instability).

Some work has already been performed in the area of possibly developing a burn-in operation as a screening test. Extra units from pre-production runs were placed on 100°C and 100% load and after 96 hours the data was analyzed and units with abnormal changes (beyond ± 3 sigma) were removed from test. The remaining units were kept on test for 2000 hours. The burn-in test proved inefficient since some units that showed normal changes after (96) hours showed up later as failures.

The units that were removed from test after (96) hours were examined and in most cases nothing significant was seen. The only obvious mechanism observed was cracked Cp-beads. Because of this a 100% pull test will be used to screen out weak terminated units processed during pilot plant operations.

V. Mechanism of Failure

Mechanism of failure studies have already been completed on units that failed moisture cycle after 100 cycles. Two modes of failure were clearly identified. A number of units showed areas where the film was attacked and removed and other units showed cracks in the Cp-bead. The film removal was probably due to inadequate overcoat protection. On checking with IRC overcoat specialists, it was discovered that the overcoat used had been in storage longer than its predicted shelf life and that adding solvent to the overcoat was not recommended. Fresh overcoat has been ordered for pilot plant runs and adding solvent will be discontinued. As mentioned above, a sub-assembly pull test will be used to screen out cracked terminations.

CONCLUSIONS

1. All pre-production testing has now been completed for the RC-07 style except for the 40 ohm Group III tests. This test will be completed shortly and the pre-production report will then be issued.
2. Pre-production testing has been completed for the RC-07, .29 megohm and the RC-20 megohm units. This data is offered for informational purposes.
3. A 100% noise and tensile pull test is planned to eliminate weak terminations on pilot run testing.
4. Based upon reliability test data, the overall failure rate of this resistor was calculated to be .21% per 1000 hours.
5. A 96 hour load life "burn-in" screening test was tried but proved inefficient.
6. Mechanism of failure studies show that failures are caused by two factors: (1) the resistance film being attacked or removed and (2) faulty termination.

PROGRAM FOR NEXT QUARTER

(July, August, September, 1962)

1. Complete Group III rerun testing on the RC-07 pre-production resistors.
2. Write and submit RC-07 pre-production report to Signal Corps.
3. Continue Pilot Run production for the RC-20 style, ranges 10 M Ω , 1/2 megohm, 300 Ω and 100M Ω .
4. Continue with 100°C load life and 175°C no load testing in order to complete the reliability requirements of the contract.

PERSONNEL

Time Spent on Contract (1 April through 30 June 1962)

PRODUCT AND PROCESS

J. Burns	78.0
D. Osborne	112.5

FACILITY DESIGN AND FABRICATION

C. Thornburg	7.5
--------------	-----

PERFORMANCE AND RELIABILITY REVIEW

A. Aniline	2.0
P. Burroughs	6.5
W. Ebling	1.5
D. Famigletti	7.5
O. Johnson	181.5
J. Sabot	148.5

TEST SECTION

258.9

TOTAL

804.4

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DATE: 10-62		TITLE: High-Stability - Pre-production # I				TYPE: RC-07			
CP-40555-H-ASSY		Performance Summary				RANGE: 40 Ω			
RUN NO: 189		TABLE I							
PC-24									
DAF-5201									
	No. Spec. Allow. Fail.	Avg.	Max.	Min.	Sigma	95%C. L.	No. Open	Total No. Fails.	% Fail 70%C. L.
Group I - (N=400)									
Visual & Mech. Insp.	0						-	0	
D.C. Resistance									
Group II - (N=35)									
Temp. Coeff. (-55°C)	2	+2.56	+2.64	+2.46	0.04	+2.43 - +2.69	0	0	
Temp. Coeff. (+105°C)		-2.67	-2.58	-2.77	0.04	-2.10 - -2.54	0	0	
Voltage Coeff.				NOT	APPLICABLE				
Dielectric Strength		+0.02	+0.34	-0.05	0.08	-0.18 - +0.34	0	0	
Insulation Resistance				ACC	ENTABLE			0	
175° No Load (2000 Hrs.)		+1.13	+9.28	-7.27	1.32	-3.49 - +5.23	0	3	
10,000 Meg.									
3.0% Avg.									
6.0% In's.									
Group III - (N=35)									
Low Temp. Storage	2*	+0.01	+0.17	-0.15	0.08	-0.25 - +0.27	0	0	
Low Temp. Operation		+0.16	+0.97	-0.02	0.03	+0.06 - +0.26	0	0	
Temperature Cycling		+0.32	+0.12	-0.59	0.11	-0.68 - 0.0	0	0	
Moisture Resistance									
Wet: Load		+1.53	+2.41	+1.07	3.67	+0.20 - +2.26	0	0	**
Polar		+0.51	+0.75	+0.32	0.14	+0.01 - +1.01	0	0	
Dielectric		+0.04	+0.07	0.00	0.01	0.0 - +0.03	2	2	
Dry: Load		+1.44	+2.37	+1.00	0.12	+0.75 - +1.61	0	5	
Polar		+0.47	+0.72	+0.29	0.15	0.0 - +1.01	0	0	
Insulation Resistance				ACC	ENTABLE			0	
Short Time Overload								0	
100 Meg.		+0.02	+0.43	-0.12	0.04	-0.11 - +0.15	0	0	
1.0%									

*Not more than (1) failure is allowed in any one char. of the Test Sub-Group.

Note: Total no. failures allowed-(4)

DATE: 10-6-2

TITLE: High Stability - Pre-production

TYPE: RC-07

RUN NO: 117

Performance Summary

PC-29
DAP-5201

TABLE I

RANGE: 40

2

		No.	Spec.	Avg.	Max.	Min.	Sigma	95% C.L.	No.	Total	% Fail
		Allow.	Limit						Open	No.	70% C.L.
		Fail.								Fail.	
Group IV - (N=130)											
100° Load Life (2000 Hrs.)		2	3.0% Avg 6.0% Indis	0.39	2.54	0.02	0.26	0.0-1.14	0	0	
Group V - (N=35)											
Terminal Strength Effect of Soldering Solder Ability	}	1	0.5%	0.64	0.23	0.00	0.06	0.00-0.27	0	0	
			1.0%	0.47	0.93	0.45	0.10	0.15-0.80	0	0	
						AS	SPECIFIED				
Group VI - (N=35)											
Acceleration Shock Hi-Freq. Vibration	}	1	1.5%	0.04	0.36	0.00	0.05	0.00-0.20	0	0	
			1.5%	0.03	0.69	0.00	0.02	0.00-0.10	0	0	
			1.5%	0.063	0.00	0.13	0.04	0.19-0.00	0	0	
Group VII - (N 130)											
Shelf-Life		1	1.0%								
Total No. Failures											
Hot Spot Temp °C 100° L.L. (N=35) 30				117°	123°	110°	0.31	116°-118°	0	0	
150° NO Load (2000 Hrs) N=40				0.62	1.35	0.373	0.53	0.37-1.13	0	0	
70° Load Life (2000 Hrs) N=130				0.28	0.51	0.53	0.09	0.02-0.54	0	0	

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DATE: C-40555-H. ASSY PC-29 RUN NO: DAP-5201	TITLE: High-Stability - Pre-production Performance Summary		TYPE: RC-07					
RANGE: 0.29 Meg								
TABLE II								
	No. Spec. Allow. Limit Fails.	Avg.	Min.	Sigma	95% C. L.	No. Open	Total No. Fails.	% Failed 70% C. L.
Group I - (N=400) Visual & Mech. Insp. D.C. Resistance	0					0	0	
Group II - (N=35) Temp. Coeff. (-55°C) Temp. Coeff. (+105°C) Voltage Coeff. Dielectric Strength Insulation Resistance 175° No Load (2000 Hrs.)	8.0% } 6.0% } 2.02% } 0.5% } 10,000 Meg } 3.0% Avg. } 6.0% Ints. }	5.55	5.10	0.23	4.79	0	0	
		4.30	4.70	0.17	3.86	0	0	
		0.034	0.047	0.007	0.057	0	0	
		0.0	0.03	0.01	0.03	0	0	
		0.0	0.03	0.01	0.03	0	0	
		0.0	0.03	0.01	0.03	0	0	
Group III - (N=35) Low Temp. Storage Low Temp. Operation Temperature Cycling Moisture Resistance Wet: Load Polar Dielectric Dry: Load Polar Insulation Resistance Short Time Overload	2* } 1.0% } 1.5% } 2.0% } 3.0% } 3.0% } 0.5% } 3.0 } 3.0 } 100 Meg } 1.0% }	0.08	0.0	0.04	0.0	0	0	
		0.02	0.49	0.08	0.28	0	1	
		0.21	0.07	0.10	0.58	0	0	
		0.81	0.47	0.10	0.45	0	1	
		0.09	0.41	0.13	0.62	0	0	
		0.00	0.03	0.01	0.03	0	0	
		0.81	0.47	0.10	0.45	0	1	
		0.96	0.41	0.13	0.49	0	0	
		0.17	0.26	0.07	0.06	0	1	
		0.17	0.26	0.07	0.06	0	1	
		0.17	0.26	0.07	0.06	0	1	
		0.17	0.26	0.07	0.06	0	1	

*Not more than (1) failure is allowed in any one char. of the Test Sub-Group.

Note: Total no. failures allowed-(4)

* * Discontinued AFTER 744 HRS.

DATE: C.P.40SSS-H-ASSY		TITLE: High Stability - Pre-production		TYPE: RC-07							
RUN NO: PC-29		Performance Summary		RANGE: 0.29 meg							
DAP-5201		TABLE II									
		No. Allow. Fails.	Spec. Limit	Avg.	Max.	Min.	Sigma	95% C.L.	No. Open	Total No. Fails	% Fails
Group IV - (N=130)											
100° Load Life (2000 Hrs.)		2	3.0% Avg 6.0% Inds	2.09	6.65	0.82	0.64	0.23-3.99	0	1	
Group V - (N=35)											
Terminal Strength		1	0.5%	0.09	0.44	0.04	0.01	0.06-0.12	0	0	
Effect of Soldering			1.0%	0.11	0.57	0.17	0.08	0.15-0.38	0	0	
Solder Ability						AS	SPECIFIED				
Group VI - (N=35)											
Acceleration		1	1.5%	0.13	0.10	0.15	0.01	0.10-0.16	0	0	
Shock			1.5%	0.04	0.03	0.07	0.01	0.01-0.07	0	0	
Hi-Freq. Vibration			1.5%	0.15	0.12	0.17	0.01	0.09-0.17	0	0	
Group VII - (N 130)											
Shelf-Life		1	1.0%								
Hot Spot Temp °C 100° L.L. (N=65) 30		Total No. Failures									
150° No Load 2000 Hrs (N=40)				120	126°	115°	2.5	112°-128°	—	—	
70° Load 1 Hr. Fe-200 Hrs (N=130)				2.75	4.54	1.00	0.88	0.0-5.62	0	0	
				0.58	3.94	1.69	0.50	0.0-2.23	0	0	

DATE:		TITLE: High-Stability - Pre-production # I				TYPE: RC-07					
RUN NO: #194		CP-40555-NASSY				RANGE: 0.45 Mcz					
PC-29		DAP-5201				TABLE III					
		No. Allow. Fails.	Spec. Limit	Avg.	Max.	Min.	Sigma	95% C. L.	No. Open	Total No. Fails.	% Fail 70% C. L.
Group I - (N=400)											
Visual & Mech. Insp.											
D.C. Resistance			0							0	
Group II - (N=35)											
Temp. Coeff. (-55°C)			8.2%	5.1	5.4	4.8	0.12	4.7-5.5	0	0	
Temp. Coeff. (+105°C)			6.0%	4.4	4.0	4.7	0.12	4.2-4.0	0	0	
Voltage Coeff.			2.02%	0.017	0.009	0.037	0.006	0.037-0.0	0	0	
Dielectric Strength			0.5%	0.003	0.03	0.04	0.01	0.03-0.03	0	0	
Insulation Resistance			10,000 Megs			ACCEPTABLE					
175° No Load (2000 Hrs.)			3.0% Avg.	4.02	7.63	7.01	—	—	0	11*	
			6.0% Incls.								
Group III - (N=35)											
Low Temp. Storage			1.0%	0.06	0.28	0.02	0.04	0.07-0.19	0	0	
Low Temp. Operation			1.5%	0.06	0.22	0.04	0.02	0.01-0.13	0	0	
Temperature Cycling			2.0%	0.17	0.19	0.43	0.10	0.50-0.16	0	0	
Moisture Resistance											
Wet: Load			3.0%	1.22	5.47	0.76	0.36	0.0-2.52	0	1	
Polar			3.0%	1.26	5.14	0.85	0.29	0.22-2.30	0	1	
Dielectric			0.5%	0.01	0.30	0.19	0.02	0.06-0.08	0	0	
Dry: Load			3.0	1.08	5.75	0.78	0.16	0.50-1.66	0	0	
Polar			3.0	1.15	5.08	0.91	0.18	0.50-1.80	0	0	
Insulation Resistance			100 Megs			ACCEPTABLE					
Short Time Overload			1.0%	0.16	0.26	0.06	0.04	0.03-0.29	0	0	

*Not more than (1) failure is allowed in any one char. of the Test Sub-Group.
 Note: Total no. failures allowed-(4)

* * - Discontinued AFTER 744 HRS.

DATE: C P-40555
PC-39

RUN NO: #194 DAP-5201

TITLE: High Stability - Pre-production # I

Performance Summary

TABLE III

TYPE: RC-07

RANGE: 0.45 meg

	No. Allow. Fails.	Spec. Limit	Avg.	Max.	Min.	Sigma	95% C.L.	No. Open	Total No. Fails	% Fail 70% C.L.
Group IV - (N=130)										
100° Load Life (2000 Hrs.)	2	3.0% Avg 6.0% Inds	0.91	1.88	0.04	0.27	8.13-169	0	0	
Group V - (N=35)										
Terminal Strength	1	0.5%	0.03	0.13	0.22	0.02	0.0-0.10	0	0	
Effect of Soldering		1.0%	0.04	0.91	0.06	0.05	0.0-0.20	0	0	
Solder Ability					AS	SPECIFIED				
Group VI - (N=35)										
Acceleration	1	1.5%	0.01	0.02	0.02	0.007	0.0-0.03	0	0	
Shock		1.5%	0.01	0.88	0.02	0.006	0.0-0.03	0	0	
Hi-Freq. Vibration		1.5%	0.03	0.03	0.06	0.002	0.0-0.06	0	0	
Group VII - (N=130)										
Shelf-Life	1	1.0%								
Total No. Failures										
Hot Spot Temp °C 100° L.L. (N=65)			111°	116°	106°	2.01	105-117	-	-	
150° No Load 2000 Hrs (N=40)			242	366	7.05	0.62	0.0-447	0	0	
70° Load Life 2000 Hrs (N=130)			0.79	2.36	2.27	0.40	0.0-3.11	0	0	

DATE: 3-6-2				TITLE: High-Stability - Pre-production				TYPE: RC-20			
4169 CP-40555 Mech-Assy				Performance Summary				RANGE: 20 Meg.			
RUN NO: DAP-5201				TABLE IV							
No. Allow. Fails.	Spec. Limit	Avg.	Max.	Min.	Sigma	95% C. L.	No. Open	Total No. Fails.	% Failed		
Group I - (N=400)											
Visual & Mech. Insp. } 0								0	0		
D.C. Resistance											
Group II - (N=35)											
Temp. Coeff. (-55 °C)				3.9	4.1	3.6	0.12	3.5-4.3	0	0	
Temp. Coeff. (+105 °C)				3.4	3.1	3.9	0.13	3.83-2.97	0	0	
Voltage Coeff. } 2				0.015	0.009	0.062	0.0003	0.025-0.005	0	0	
Dielectric Strength				0.02	0.12	0.0	0.02	0.00-0.09	0	0	
Insulation Resistance						ACCE	PTABLE				
175° No Load (2000 Hrs.)				7.41	80.42	4.75	—	—	0	33*	
Group III - (N=35)											
Low Temp. Storage				0.08	0.22	0.03	0.04	0.00-0.21	0	0	
Low Temp. Operation				0.03	0.05	0.51	0.02	0.04-0.10	0	0	
Temperature Cycling				0.08	0.58	0.21	0.04	0.21-0.0	0	0	
Moisture Resistance				0.52	4.37	0.42	0.06	0.46-0.58	0	1	
Wet: Load				0.63	1.54	0.11	0.23	0.0-1.46	0	0	
Polar				0.01	0.03	0.41	0.01	0.04-0.02	0	0	
Dielectric				0.60	4.46	0.49	0.05	0.42-0.78	0	0	
Dry: Load				0.65	1.59	0.19	0.13	0.18-1.12	0	0	
Polar						ACCE	PTABLE				
Insulation Resistance				0.01	0.05	0.30	0.06	0.21-0.19	0	0	
Short Time Overload											

*Not more than (1) failure is allowed in any one char. of the Test Sub-Group.

Note: Total no. failures allowed-(4)

** DISCONTINUED AFTER 1600 HRS.

DATE: 3-62

169 P.P. 40555-MACH. ASSY

RUN NO: DAP. 5201

TITLE: High Stability - Pre-production
Performance Summary

TABLE IV

TYPE: RC-20

RANGE: 0.20 Mcg

		No. Allow. Fails.	Spec. Limit	Avg.	Max.	Min.	Sigma	95% C.L.	No. Open	Total No. Fails.	% Fails 70% C.L.
Group IV - (N=130)											
100° Load Life (2000 Hrs.)		2	3.0% Avg 6.0% Inds	73.12	77.1	71.49	1.58	00-7.67	1	8	
Group V - (N=35)											
Terminal Strength Effect of Soldering Solder Ability	}	1	0.5%	0.04	to 0.17	-0.04	0.04	00-0.19	0	0	
			1.0%	0.06	to 0.31	-0.07	0.03	0.15-0.63	0	1	
						AS	SPECIAL				
Group VI - (N=35)											
Acceleration Shock Hi-Freq. Vibration	}	1	1.5%	0.023	to 0.04	to 0.01	0.01	0.00-0.04	0	0	
			1.5%	0.013	0.00	-0.03	0.01	0.00-0.03	0	0	
			1.5%	0.041	to 0.14	-0.17	0.01	0.11-0.17	0	0	
Group VII - (N=130)											
Shelf-Life		1	1.0%								
Total No. Failures											
Hot Spot Temp °C 100° L.L. (25-05)/(30)				139°	151°	125°	446	124°-154°	-	-	
150° No Load (2000 Hrs) N=40				71.96	72.93	-0.13	0.68	0.28-4.20	0	0	
70° Load Life (2000 Hrs) N=130				71.79	75.06	70.72	0.55	0.20-3.38	3	3	

TABLE I- HIGH STABILITY- RELIABILITY EVALUATION SUMMARY

TEST Low Temperature Storage- Spec Limit +1 %

PAGE 1 OF 1

RUN NO. - RANGE	CYCLES										TOTAL NO FAILS
	1	2	3	4	5	6	7	8	9	10	
24Ω	AV	+ 0.42	+ 0.06	+ 0.02	+ 0.065	+ 0.035	+ 0.09	+ 0.03	+ 0.01	- 0.02	+ 0.01
	50%	+ 0.78	+ 0.29	+ 0.20	+ 0.16	+ 0.16	+ 0.28	+ 0.16	+ 0.04	+ 0.04	+ 0.12
	FAIL	- 0.08	0.00	0.00	0.00	0.00	- 0.08	0.00	0.00	- 0.12	- 0.12
	FAIL	0/20	0/20	0/20	0/20	0/20	0	0	0	0	0
300Ω	AV	+ 0.10	+ 0.015	+ 0.01	+ 0.02	- 0.01	+ 0.04	+ 0.06	- 0.02	- 0.01	+ 0.03
	50%	+ 0.16	+ 0.09	+ 0.03	+ 0.05	0.00	+ 0.09	+ 0.07	+ 0.01	0.00	+ 0.06
	FAIL	+ 0.06	- 0.01	0.00	+ 0.01	- 0.03	+ 0.02	+ 0.04	- 0.30	- 0.02	+ 0.02
	FAIL	0/20	0/20	0/20	0/20	0/20	0	0	0	0	0
0.27Meg	AV	+ 0.095	+ 0.015	+ 0.035	+ 0.02	- 0.03	+ 0.06	+ 0.08	0.00	+ 0.01	+ 0.07
	50%	+ 0.18	+ 0.08	+ 0.11	+ 0.11	0.00	+ 0.11	+ 0.12	+ 0.02	+ 0.07	+ 0.17
	FAIL	+ 0.04	- 0.01	0.00	0.00	- 0.04	+ 0.04	+ 0.05	- 0.02	- 0.01	+ 0.04
	FAIL	0/20	0/20	0/20	0/20	0/20	0	0	0	0	0
0.48Meg	AV	+ 0.07	+ 0.005	+ 0.005	+ 0.025	- 0.02	+ 0.07	+ 0.04	- 0.03	0.00	+ 0.07
	50%	+ 0.10	+ 0.04	+ 0.03	+ 0.08	+ 0.01	+ 0.09	+ 0.08	- 0.01	+ 0.01	+ 0.10
	FAIL	+ 0.04	- 0.01	- 0.02	0.00	- 0.05	+ 0.05	+ 0.01	+ 0.04	- 0.02	+ 0.04
	FAIL	0/20	0/20	0/20	0/20	0/20	0	0	0	0	0
TOTAL NO. FAILS											0/80
38Ω	AV	+ 0.085	+ 0.11	+ 0.055	+ 0.055	- 0.005	+ 0.05	- 0.005	+ 0.04	0.00	- 0.03
	50%	+ 0.26	+ 0.27	+ 0.26	+ 0.13	+ 0.08	+ 0.16	0.00	+ 0.08	+ 0.03	0.00
	FAIL	- 0.08	- 0.08	0.00	0.00	- 0.08	0.00	- 0.03	0.00	- 0.08	- 0.18
	FAIL	0/20	0/20	0/20	0/20	0/20	0	0	0	0	0
2800Ω	AV	- 0.005	+ 0.06	+ 0.025	+ 0.005	+ 0.005	+ 0.03	- 0.025	+ 0.05	0.00	- 0.01
	50%	+ 0.03	+ 0.12	+ 0.07	+ 0.02	+ 0.07	+ 0.06	+ 0.05	+ 0.07	+ 0.02	0.00
	FAIL	- 0.03	+ 0.03	0.00	0.00	0.00	+ 0.01	- 0.04	+ 0.04	- 0.01	- 0.02
	FAIL	0/20	0/20	0/20	0/20	0	0	0	0	0	0
0.24Meg	AV	- 0.045	+ 0.04	- 0.005	0.00	+ 0.005	+ 0.03	- 0.05	+ 0.07	0.00	- 0.01
	50%	0.00	+ 0.10	+ 0.07	+ 0.01	+ 0.04	+ 0.07	- 0.04	+ 0.09	+ 0.01	0.00
	FAIL	- 0.08	+ 0.02	- 0.40	- 0.02	0.00	0.00	- 0.07	+ 0.06	- 0.03	- 0.03
	FAIL	0/20	0/20	0/20	0/20	0/20	0	0	0	0	0
0.48Meg	AV	+ 0.065	+ 0.06	+ 0.015	0.005	+ 0.025	+ 0.02	- 0.08	+ 0.09	- 0.01	- 0.02
	50%	+ 0.10	+ 0.10	+ 0.06	+ 0.02	+ 0.08	+ 0.04	- 0.06	+ 0.12	+ 0.01	0.00
	FAIL	- 0.11	+ 0.03	- 0.01	- 0.02	0.00	+ 0.01	- 0.10	+ 0.07	- 0.02	- 0.02
	FAIL	0/20	0/20	0/20	0/20	0/20	0	0	0	0	0
TOTAL NO. FAILS											0/80

TABLE II HIGH STABILITY - RELIABILITY EVALUATION SUMMARY

TEST 175° No Load Spec Limit $\pm 6.0\%$ Page 1 of

RUN NO. - RANGE	HOURS												TOTAL NO. FAILS
	48	96	240	504	744	1008	1500	2000	2500	3000			
24Ω	AV	+ 0.18	+ 0.90	+ 2.36	+ 2.54	+ 1.23	+ 0.16	+ 1.30	+ 6.34	+ 21.54			
	MIN	+ 1.28	+ 2.51	+ 3.39	+ 5.59	+ 3.73	+ 3.30	+ 7.58	+ 24.46	+ 18.67			
	MAX	- 0.17	+ 0.21	+ 1.09	+ 0.29	- 0.72	- 1.96	- 2.98	- 2.59	- 1.91			
300Ω	AV	0	0	0	0	0	0	2	7	16			
	MIN	- 0.82	- 0.92	- 0.21	+ 1.15	+ 2.74	+ 4.38	+ 7.69	+ 9.16				
	MAX	- 0.50	+ 1.69	+ 2.65	+ 3.58	+ 5.31	+ 6.66	+ 10.17	+ 11.80				
.27Meg	AV	- 1.08	- 3.54	- 3.32	- 1.28	+ 0.25	+ 2.31	+ 5.32	+ 6.48				
	MIN	0	0	0	0	0	3	13	20				
	MAX	- 1.16	- 1.10	+ 0.38	+ 3.84	+ 6.60	+ 8.54						
.48Meg	AV	+ 0.05	+ 0.15	+ 5.50	+ 9.52	+ 13.61	+ 10.79						
	MIN	- 1.46	- 1.60	- 1.62	- 1.33	+ 1.71	+ 5.27	+ 9.07					
	MAX	0	0	0	2	13	19	20					
TOTAL NO. FAILS	AV	- 0.83	- 0.84	+ 0.10	+ 2.81	+ 5.77	+ 8.32	+ 11.32					
	MIN	- 0.16	+ 0.60	+ 3.24	+ 6.87	+ 9.31	+ 11.13	+ 13.61					
	MAX	- 1.12	- 1.49	- 1.38	- 1.14	+ 2.60	+ 6.47	+ 9.66					
R C 07													
TOTAL NO. FAILS													16
38Ω	AV	+ 0.07	+ 0.68	+ 2.00	+ 2.97	+ 2.71	+ 2.69	+ 7.70	+ 44.23	+ 62.58			
	MIN	+ 0.33	+ 1.65	+ 3.76	+ 5.41	+ 8.08	+ 10.20	+ 13.51	+ 80.46	+ 99.99			
	MAX	- 0.21	+ 0.11	+ 0.05	- 0.63	- 0.81	- 0.81	+ 0.50	+ 1.80	+ 7.61			
280Ω	AV	0	0	0	0	3	4	18	18	20			
	MIN	- 0.46	- 0.39	+ 0.24	+ 1.49	+ 2.32	+ 2.91	+ 4.19	+ 4.73	+ 5.34			
	MAX	+ 1.56	+ 0.29	+ 1.08	+ 2.52	+ 2.84	+ 3.56	+ 4.94	+ 5.88	+ 6.85			
.24Meg	AV	- 2.50	- 0.82	- 0.69	+ 0.33	+ 1.72	+ 2.29	+ 3.65	+ 4.05	+ 4.59			
	MIN	0	0	0	0	0	0	0	0	3			
	MAX	- 0.56	- 0.45	+ 0.17	+ 1.80	+ 3.80	+ 5.79	+ 8.09					
.48Meg	AV	+ 2.50	+ 1.02	+ 2.59	+ 5.12	+ 6.59	+ 7.83	+ 9.74					
	MIN	- 3.88	- 0.97	- 0.95	- 0.89	+ 1.06	+ 3.84	+ 6.80					
	MAX	0	0	0	0	1	8	20					
TOTAL NO. FAILS	AV	- 1.34	- 1.43	- 0.45	+ 3.32	+ 6.66	+ 9.58						
	MIN	- 0.53	- 0.19	+ 2.23	+ 5.75	+ 9.57	+ 12.60						
	MAX	- 1.80	- 2.21	- 1.97	- 1.66	+ 0.82	+ 6.06						
R C 20													
TOTAL NO. FAILS													23

TABLE VII HIGH STABILITY-RELIABILITY EVALUATION SUMMARY

TEST 100° Load Life Spec. Limit $\pm 6.0\%$ PAGE 1 OF

RUN NO. - RANGE		HOURS												TOTAL NO. FAILS
		48	96	192	504	744	1008	1500	2000	2500	3000			
24Ω	AV	+ 0.09	+ 0.17	+ 0.27	+ 0.32	+ 0.66	+ 0.43	+ 0.55	+ 0.57	+ 0.49	+ 0.66	RC	07	TOTAL NO. FAILS
	SD	+ 0.29	+ 0.37	+ 0.45	+ 0.65	+ 1.20	+ 1.00	+ 1.88	+ 1.62	+ 2.45	+ 2.03			
	RM	0.00	+ 0.08	+ 0.12	+ 0.12	+ 0.42	+ 0.13	+ 0.13	+ 0.33	- 0.53	+ 0.25			
	AV	0	0	0	0	0	0	0	0	0	0			
	SD	- 0.02	- 0.08	- 0.10	- 0.17	- 0.07	- 0.01	+ 0.19	+ 0.47	+ 0.63	+ 0.83			
3000Ω	AV	+ 0.57	+ 0.05	+ 0.07	+ 0.17	+ 0.39	+ 0.56	+ 0.38	+ 1.19	+ 1.41	+ 1.65	RC	07	TOTAL NO. FAILS
	SD	+ 0.17	- 0.24	- 0.33	- 0.55	- 0.51	- 0.50	- 0.32	- 0.03	+ 0.12	+ 0.30			
	RM	0	0	0	0	0	0	0	0	0	0			
	AV	- 0.02	- 0.08	- 0.10	- 0.17	- 0.07	- 0.01	+ 0.19	+ 0.47	+ 0.63	+ 0.83			
	SD	+ 0.57	+ 0.05	+ 0.07	+ 0.17	+ 0.39	+ 0.56	+ 0.38	+ 1.19	+ 1.41	+ 1.65			
.27Meg	AV	- 0.25	- 0.19	- 0.05	+ 0.42	+ 0.97	+ 1.35	+ 2.14	+ 2.93	+ 3.53	+ 1.32	RC	07	TOTAL NO. FAILS
	SD	+ 0.29	+ 0.35	+ 0.41	+ 1.49	+ 2.24	+ 2.60	+ 3.43	+ 4.56	+ 5.31	+ 6.24			
	RM	- 0.78	+ 0.59	- 0.44	- 0.22	+ 0.04	+ 0.12	+ 0.49	+ 1.25	+ 1.31	+ 1.70			
	AV	0	0	0	0	0	0	0	0	0	2			
	SD	- 0.17	- 0.16	- 0.17	- 0.24	- 0.01	+ 0.15	+ 0.44	+ 0.86	+ 1.14	+ 1.41			
.48Meg	AV	+ 0.09	+ 0.42	+ 0.44	+ 0.45	+ 0.78	+ 0.95	+ 1.33	+ 1.77	+ 1.96	+ 2.26	RC	07	TOTAL NO. FAILS
	SD	- 0.40	- 0.47	- 0.55	- 0.63	- 0.41	- 0.34	- 0.04	+ 0.37	+ 0.65	+ 0.90			
	RM	0	0	0	0	0	0	0	0	0	0			
	AV	- 0.17	- 0.16	- 0.17	- 0.24	- 0.01	+ 0.15	+ 0.44	+ 0.86	+ 1.14	+ 1.41			
	SD	+ 0.09	+ 0.42	+ 0.44	+ 0.45	+ 0.78	+ 0.95	+ 1.33	+ 1.77	+ 1.96	+ 2.26			
TOTAL NO. FAILS		0	0	0	0	0	0	0	0	0	2			
1														
38Ω	AV	+ 0.75	+ 0.01	+ 0.09	+ 0.34	+ 0.76	+ 1.05	+ 0.63	+ 0.70	+ 1.32	+ 1.00	RC	20	TOTAL NO. FAILS
	SD	+ 0.85	+ 0.13	+ 0.19	+ 0.54	+ 1.24	+ 1.37	+ 1.10	+ 1.31	+ 2.14	+ 1.86			
	RM	+ 0.65	- 0.08	- 0.05	+ 0.13	+ 0.50	+ 0.79	+ 0.29	+ 0.27	+ 0.70	+ 0.32			
	AV	0	0	0	0	0	0	0	0	0	0			
	SD	- 0.64	- 0.16	- 0.12	+ 0.13	+ 0.28	+ 0.41	+ 0.64	+ 0.87	+ 1.32	+ 1.38			
2800Ω	AV	+ 0.72	- 0.09	+ 0.02	+ 0.38	+ 0.67	+ 0.74	+ 1.24	+ 1.65	+ 2.25	+ 2.43	RC	20	TOTAL NO. FAILS
	SD	+ 0.55	- 0.26	- 0.27	- 0.14	- 0.08	- 0.02	+ 0.12	+ 0.28	+ 0.70	+ 0.66			
	RM	0	0	0	0	0	0	0	0	0	0			
	AV	- 0.61	- 0.34	- 0.05	+ 0.36	+ 0.69	+ 1.25	+ 1.97	+ 3.08	+ 3.61	+ 3.66			
	SD	+ 0.93	+ 0.09	+ 0.54	+ 1.96	+ 2.60	+ 3.44	+ 4.58	+ 5.47	+ 6.26	+ 7.25			
.24 Meg	AV	+ 0.27	- 0.65	- 0.72	- 6.31	- 7.87	- 6.56	- 6.75	- 0.14	+ 0.15	+ 0.30	RC	20	TOTAL NO. FAILS
	SD	0	0	0	1	1	1	1	1	4	4+1open			
	RM	0	0	0	0	0	0	0	0	0	0			
	AV	+ 1.36	- 0.09	+ 0.03	+ 0.31	+ 0.86	+ 0.30	+ 0.80	+ 1.14	+ 1.60	+ 1.91			
	SD	+ 1.57	+ 0.10	+ 0.33	+ 0.81	+ 1.80	+ 1.09	+ 1.52	+ 2.05	+ 2.63	+ 2.43			
.48Meg	AV	+ 0.94	- 0.96	- 0.65	- 0.90	- 0.96	- 1.02	- 0.59	- 0.35	+ 0.07	+ 0.37	RC	20	TOTAL NO. FAILS
	SD	0	0	0	0	0	0	0	0	0	0			
	RM	0	0	0	0	0	0	0	0	0	0			
	AV	- 0.17	- 0.16	- 0.17	- 0.24	- 0.01	+ 0.15	+ 0.44	+ 0.86	+ 1.14	+ 1.41			
	SD	+ 0.09	+ 0.42	+ 0.44	+ 0.45	+ 0.78	+ 0.95	+ 1.33	+ 1.77	+ 1.96	+ 2.26			
TOTAL NO. FAILS		0	0	0	1	2	2	1+1open	1+1open	4+1open	4+2open			

TABLE III HIGH STABILITY-RELIABILITY EVALUATION SUMMARY

TEST Hi-Freq- Vibration Spec. Limit + 1.5 % PAGE OF

RUN NO. - RANGE	CYCLES										TOTAL NO FAILS
	1	2	3	4	5	6	7	8	9	10	
0.28Meg	AV	- 0.03	- 0.06	+ 0.05	+ 0.11	- 0.04	- 0.09	- 0.02	+ 0.02	- 0.05	+ 0.08
	STDEV	0.00	0.00	+ 0.12	+ 0.21	0.00	- 0.04	- 0.00	+ 0.04	+ 0.25	+ 0.30
	FAIL	- 0.04	- 0.08	0.00	+ 0.04	+ 0.12	- 0.16	- 0.04	0.00	- 0.26	- 0.25
30002	AV	0	0	0	0	0	0	0	0	0	0
	STDEV	- 0.03	- 0.05	+ 0.03	+ 0.12	- 0.06	- 0.11	- 0.02	+ 0.01	+ 0.07	- 0.05
	FAIL	- 0.02	- 0.04	+ 0.04	+ 0.14	- 0.05	- 0.10	- 0.02	+ 0.02	+ 0.08	- 0.02
0.27Meg	AV	- 0.03	- 0.05	+ 0.02	+ 0.10	- 0.06	- 0.12	- 0.03	0.00	+ 0.06	- 0.08
	STDEV	0	0	0	0	0	0	0	0	0	0
	FAIL	- 0.09	- 0.11	+ 0.02	- 0.01	+ 0.16	+ 0.24	- 0.10	+ 0.08	- 0.05	0.17
0.48Meg	AV	- 0.05	- 0.07	+ 0.05	+ 0.01	+ 0.57	+ 0.27	- 0.09	+ 0.11	- 0.03	- 0.16
	STDEV	- 0.27	- 0.14	0.00	- 0.01	+ 0.11	+ 0.21	- 0.10	+ 0.08	- 0.06	- 0.17
	FAIL	0	0	0	0	0	0	0	0	0	0
0.48Meg	AV	- 0.06	- 0.10	+ 0.05	- 0.02	+ 0.12	+ 0.23	- 0.08	+ 0.08	+ 0.05	- 0.17
	STDEV	- 0.05	- 0.08	+ 0.08	+ 0.01	+ 0.32	+ 0.25	- 0.08	+ 0.09	- 0.04	- 0.16
	FAIL	- 0.10	- 0.13	+ 0.03	- 0.03	+ 0.09	+ 0.21	- 0.09	+ 0.06	+ 0.06	- 0.18
TOTAL NO. FAILS											0
R C 2 0											0
382	AV	- 0.01	- 0.05	+ 0.05	- 0.04	- 0.01	- 0.05	- 0.13	+ 0.11	+ 0.08	+ 0.06
	STDEV	+ 0.03	0.00	+ 0.11	0.00	+ 0.05	0.00	- 0.08	+ 0.16	+ 1.48	+ 0.13
	FAIL	- 0.41	- 0.11	0.00	- 0.10	- 0.08	- 0.13	- 0.18	+ 0.05	- 0.03	0.00
29002	AV	0	0	0	0	0	0	0	0	0	0
	STDEV	- 0.02	- 0.04	+ 0.02	- 0.04	+ 0.06	- 0.01	- 0.07	+ 0.08	+ 0.03	+ 0.05
	FAIL	+ 0.05	- 0.01	+ 0.04	0.00	+ 0.10	+ 0.01	- 0.06	+ 0.09	- 0.01	+ 0.06
0.24Meg	AV	- 0.14	- 0.09	+ 0.01	- 0.10	+ 0.02	- 0.02	- 0.08	+ 0.05	- 0.04	+ 0.02
	STDEV	0	0	0	0	0	0	0	0	0	0
	FAIL	- 0.11	- 0.05	+ 0.03	- 0.06	+ 0.09	- 0.02	- 0.09	+ 0.10	- 0.05	+ 0.10
.48Meg	AV	- 0.09	- 0.04	+ 0.05	- 0.05	+ 0.11	+ 0.01	- 0.06	+ 0.11	- 0.03	+ 0.11
	STDEV	- 0.12	- 0.06	- 0.03	- 0.08	+ 0.07	- 0.04	- 0.10	+ 0.09	- 0.07	+ 0.08
	FAIL	0	0	0	0	0	0	0	0	0	0
.48Meg	AV	+ 0.01	- 0.07	+ 0.17	- 0.17	- 0.01	- 0.13	- 0.28	+ 0.22	+ 0.02	+ 0.11
	STDEV	+ 0.03	- 0.02	+ 0.93	- 0.06	0.00	- 0.10	- 0.26	+ 0.24	+ 0.03	+ 0.12
	FAIL	- 0.01	0.10	+ 0.05	- 0.93	- 0.04	- 0.15	- 0.31	+ 0.20	+ 0.01	+ 0.09
TOTAL NO. FAILS											0

TABLE II HIGH STABILITY-RELIABILITY EVALUATION SUMMARY

TEST Shock Spec Jitter ± 1.5%		CYCLES										TOTAL NO. FAILS		PAGE 1 OF 1	
RUN NO.- RANGE	AV	1	2	3	4	5	6	7	8	9	10	TOTAL NO. FAILS	RANGE	0/20	1/20
		AV	AV	AV	AV	AV	AV	AV	AV	AV	AV				
20Ω	AV	- 0.02	- 0.02	- 0.01	+ 0.04	- 0.01	- 0.02	+ 0.02	- 0.02	+ 0.02	+ 0.02	0/20	0/20		
	AV	0.00	+ 0.13	+ 0.04	+ 0.17	+ 0.04	0.00	+ 0.13	0.00	+ 0.13	+ 0.02	0/20	0/20		
	AV	- 0.13	- 0.04	- 0.13	0.00	- 0.13	- 0.04	0.00	- 0.13	0.00	- 0.13	0/20	0/20		
	AV	0	0	0	0	0	0	0	0	0	0	0/20	0/20		
'3000Ω	AV	0.00	- 0.02	+ 0.03	0.00	- 0.03	- 0.01	+ 0.02	+ 0.07	+ 0.02	+ 0.01	0/20	0/20		
	AV	+ 0.01	+ 0.02	+ 0.06	+ 0.04	- 0.03	- 0.01	+ 0.07	+ 0.14	+ 0.23	+ 0.02	0/20	0/20		
	AV	- 0.02	- 0.06	0.00	- 0.03	- 0.04	- 0.02	+ 0.01	+ 0.04	- 0.01	- 0.16	0/20	0/20		
	AV	0	0	0	0	0	0	0	0	0	0	0/20	0/20		
.27Meg	AV	+ 0.01	- 0.05	+ 0.03	0.00	+ 0.01	- 0.03	+ 0.03	+ 0.03	+ 0.04	+ 0.03	0/20	0/20		
	AV	+ 0.03	± 0.03	+ 0.04	+ 0.03	+ 0.02	- 0.03	+ 0.05	- 0.03	+ 0.07	+ 0.06	0/20	0/20		
	AV	- 0.01	- 0.04	0.00	- 0.25	0.00	- 0.03	+ 0.00	- 0.03	+ 0.02	+ 0.03	0/20	0/20		
	AV	0	0	0	0	0	0	0	0	0	0	0/20	0/20		
.48Meg	AV	- 0.03	- 0.04	+ 0.03	+ 0.04	- 0.04	- 0.03	+ 0.01	- 0.03	+ 0.03	+ 0.03	0/20	0/20		
	AV	0.00	- 0.01	+ 0.10	+ 0.06	- 0.02	+ 0.00	+ 0.02	+ 0.14	+ 0.06	+ 0.04	0/20	0/20		
	AV	- 0.17	- 0.18	- 0.02	- 0.06	- 0.12	- 0.04	0.00	- 0.18	0.00	- 0.04	0/20	0/20		
	AV	0	0	0	0	0	0	0	0	0	0	0/20	0/20		
TOTAL NO. FAILS		0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80
R C															
38Ω	AV	+ 0.04	+ 0.04	- 0.03	- 0.09	+ 0.04	- 0.03	- 0.02	+ 0.09	- 0.06	+ 0.02	0/20	0/20		
	AV	+ 1.04	+ 0.22	+ 0.13	0.00	+ 0.13	+ 0.03	0.00	+ 0.16	+ 0.03	+ 0.11	0/20	0/20		
	AV	- 0.08	- 0.79	- 0.57	- 1.19	- 0.05	- 0.11	- 0.03	0.00	- 0.14	- 0.03	0/20	0/20		
	AV	0	0	0	0	0	0	0	0	0	0	0/20	0/20		
2800Ω	AV	+ 0.02	+ 0.01	- 0.02	- 0.01	- 0.01	0.00	0.00	0.00	+ 0.01	- 0.01	0/20	0/20		
	AV	+ 0.06	+ 0.06	- 0.01	0.00	0.00	+ 0.03	+ 0.03	0.00	+ 0.14	+ 0.02	0/20	0/20		
	AV	- 0.01	- 0.05	- 0.08	- 0.02	- 0.02	- 0.03	- 0.02	- 0.01	- 0.02	- 0.14	0/20	0/20		
	AV	0	0	0	0	0	0	0	0	0	0	0/20	0/20		
.24Meg	AV	+ 0.08	- 0.01	- 0.02	- 0.01	- 0.01	+ 0.04	0.00	0.00	- 0.01	0.00	0/20	0/20		
	AV	+ 0.09	0.00	- 0.01	0.06	0.00	+ 0.06	+ 0.02	+ 0.04	+ 0.00	+ 0.02	0/20	0/20		
	AV	+ 0.06	- 0.02	- 0.03	- 0.02	- 0.03	+ 0.02	- 0.02	- 0.02	- 0.02	- 0.01	0/20	0/20		
	AV	0	0	0	0	0	0	0	0	0	0	0/20	0/20		
0.48Meg	AV	- 0.03	+ 0.02	+ 0.04	- 0.03	+ 0.02	- 0.03	- 0.03	+ 0.14	- 0.09	+ 0.06	0/20	0/20		
	AV	- 0.01	+ 0.04	+ 0.20	- 0.02	+ 0.04	0.00	+ 0.04	+ 0.15	- 0.07	+ 0.07	0/20	0/20		
	AV	- 0.04	- 0.10	+ 0.08	- 0.04	- 0.06	- 0.06	- 0.04	+ 0.10	- 0.13	+ 0.04	0/20	0/20		
	AV	0	0	0	0	0	0	0	0	0	0	0/20	0/20		
TOTAL NO. FAILS		0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80	0/80
R C															
20															

TABLE I HIGH STABILITY - RELIABILITY EVALUATION SUMMARY

TEST Acceleration - Spec. Limit + 1.5%

PAGE 1 OF 1

RUN NO. - RANGE	CYCLES										TOTAL NO FAILS
	1	2	3	4	5	6	7	8	9	10	
24Ω	AV	- 0.05	0.02	- 0.01	+ 0.01	0.00	+ 0.01	0.00	0.00	+ 0.03	0/20
	MIN	0.00	+ 0.13	+ 0.04	+ 0.13	+ 0.13	0.00	0.00	+ 0.04	+ 0.13	
	MAX	- 0.17	- 0.04	- 0.13	0.00	0.04	- 0.13	- 0.04	- 0.13	- 0.04	
3000Ω	AV	0	0	0	0	0	0	0	0	0	0/20
	MIN	+ 0.01	- 0.01	- 0.01	+ 0.01	- 0.01	- 0.03	+ 0.02	- 0.02	+ 0.01	
	MAX	+ 0.05	0.00	0.00	+ 0.03	+ 0.01	0.00	+ 0.03	- 0.01	+ 0.02	
.27Meg	AV	0.00	- 0.02	- 0.02	- 0.04	- 0.03	- 0.01	0.00	- 0.03	0.00	0/20
	MIN	0	0	0	0	0	0	0	0	0	
	MAX	- 0.01	0.00	0.00	- 0.02	+ 0.01	+ 0.01	- 0.01	+ 0.01	+ 0.01	
.40Meg	AV	+ 0.01	+ 0.02	+ 0.01	+ 0.08	+ 0.02	- 0.04	+ 0.01	+ 0.02	+ 0.04	0/20
	MIN	- 0.02	- 0.01	- 0.01	- 0.97	0.00	- 0.07	- 0.02	- 0.01	- 0.15	
	MAX	0	0	0	0	0	0	0	0	0	
TOTAL NO. FAILS											0/80
0											0
38Ω	AV	+ 0.02	- 0.01	+ 0.06	+ 0.02	+ 0.01	- 0.01	+ 0.08	- 0.10	0.00	1/20
	MIN	+ 0.21	+ 0.08	+ 0.79	0.00	+ 0.03	+ 0.12	+ 0.81	0.00	+ 0.08	
	MAX	- 0.08	- 0.10	0.00	- 0.08	0.00	- 0.03	0.00	- 0.28	- 0.03	
2800Ω	AV	0	0	0	1	0	0	0	0	0	0/20
	MIN	- 0.06	- 0.01	- 0.01	0.00	0.00	0.00	0.00	- 0.01	0.00	
	MAX	- 0.03	0.00	0.00	0.00	+ 0.02	+ 0.01	+ 0.04	+ 0.01	0.00	
.24Meg	AV	- 0.10	- 0.02	- 0.02	- 0.02	- 0.02	- 0.02	0.00	- 0.04	- 0.01	0/20
	MIN	0	0	0	0	0	0	0	0	0	
	MAX	- 0.07	- 0.01	- 0.02	0.00	+ 0.01	0.00	0.00	- 0.01	0.00	
.18Meg	AV	- 0.05	0.00	0.00	+ 0.02	+ 0.02	+ 0.02	+ 0.02	0.00	+ 0.02	0/20
	MIN	- 0.10	- 0.03	- 0.04	- 0.02	- 0.01	- 0.02	- 0.02	- 0.03	- 0.02	
	MAX	0	0	0	0	0	0	0	0	0	
.18Meg	AV	- 0.03	0.00	+ 0.02	- 0.02	0.00	+ 0.03	- 0.01	- 0.04	+ 0.02	0/20
	MIN	0.00	+ 0.02	+ 0.18	+ 0.05	0.00	+ 0.50	+ 0.16	+ 0.01	+ 0.04	
	MAX	- 0.06	- 0.02	0.00	- 0.12	- 0.10	- 0.02	- 0.09	- 0.67	0.00	
TOTAL NO. FAILS											1/20
0											0

TABLE II HIGH STABILITY - RELIABILITY EVALUATION SUMMARY

TEST Moisture Resistance- Wet (Load) Spec. Limit + 3.0% PAGE OF

RUN NO. - RANGE		CYCLES													TOTAL NO FAILS
		10	20	30	40	50	60	70	80	90	100				
R 24Ω	AV	+ 0.58	+ 0.62	+ 0.65	+ 0.61	+ 0.60	+ 0.64	+ 0.69	+ 0.62	+ 0.62	+ 0.66				
	SP	+ 0.97	+ 1.08	+ 1.20	+ 1.32	+ 1.32	+ 1.36	+ 1.40	+ 1.40	+ 1.44	+ 1.48				
	FAIL	+ 0.41	+ 0.41	+ 0.41	+ 0.36	+ 0.36	+ 0.40	+ 0.41	+ 0.33	+ 0.33	+ 0.40			0	
C 3000Ω	AV	0	0	0	0	0	0	0	0	0	0				
	SP	+ 0.52	+ 0.61	+ 1.19	+ 0.67	+ 0.72	+ 0.80	+ 0.80	+ 0.87	+ 0.90	+ 0.97			0	
	FAIL	+ 0.62	+ 0.20	+ 1.32	+ 0.76	+ 0.84	+ 0.92	+ 0.89	+ 0.99	+ 1.02	+ 1.13				
O 7 0.27Meg	AV	+ 0.42	+ 0.53	+ 1.06	+ 0.62	+ 0.63	+ 0.74	+ 0.67	+ 0.78	+ 0.81	+ 0.88				
	SP	0	0	0	0	0	0	0	0	0	0				
	FAIL	2.45	3.69	4.18	4.57	4.92	5.12	5.36	5.61	5.77	6.06			6 + 1	
C 0.48Meg	AV	+ 9.07	+ 10.27	+ 10.85	+ 11.21	+ 11.59	+ 12.01	+ 12.47	+ 12.87	+ 13.23	+ 13.76				
	SP	+ 0.18	+ 1.15	+ 1.23	+ 1.22	+ 1.38	+ 1.49	+ 1.52	+ 1.71	+ 1.81	+ 1.95				
	FAIL	3+1open	4+1open	4+1open	4+1open	4+1open	4+1open	6+1open	5+1open	5+1open	6+1open			open	
C 0.48Meg	AV	+ 2.76	+ 3.26	+ 3.89	+ 3.87	+ 4.14	+ 4.46	+ 4.50	+ 4.90	+ 5.06	+ 5.20				
	SP	+ 6.36	+ 7.48	+ 8.19	+ 8.96	+ 9.96	+ 10.86	+ 11.80	+ 12.33	+ 12.69	+ 13.12			9	
	FAIL	+ 1.12	+ 1.40	+ 1.58	+ 1.77	+ 1.83	+ 2.03	+ 2.34	+ 2.40	+ 2.42	+ 2.47				
TOTAL NO. FAILS		7+1 open	9+1open	9+1open	9+1open	9+1open	10+1open	12+1open	13+1open	14+1open	15+1open	15+1open	15+1open	15+1open	
R 38Ω	AV	+ 0.31	+ 0.34	+ 0.43	+ 0.78	+ 0.54	+ 0.67	+ 0.76	+ 0.78	+ 0.79	+ 0.82				
	SP	+ 0.40	+ 0.48	+ 0.90	+ 1.39	+ 1.27	+ 1.54	+ 2.02	+ 2.05	+ 2.08	+ 2.10				
	FAIL	+ 0.22	+ 0.24	+ 0.24	+ 0.27	+ 0.22	+ 0.19	+ 0.19	+ 0.19	+ 0.19	+ 0.22			0	
C 2800Ω	AV	+ 0.21	+ 0.39	+ 0.36	+ 0.44	+ 0.35	+ 0.74	+ 0.52	+ 0.50	+ 0.61	+ 0.66				
	SP	+ 4.98*	+ 8.96*	+ 9.03*	+ 9.16*	+ 9.26*	+ 26.03*	+ 26.96*	+ 37.96*	+ 41.29*	+ 44.74*			1	
	FAIL	+ 0.18	+ 0.35	+ 0.29	+ 0.36	+ 0.18	+ 0.64	+ 0.40	+ 0.47	+ 0.49	+ 0.54				
C 2.4Meg	AV	+ 0.57	+ 0.86	+ 1.17	+ 1.87	+ 1.83	+ 1.91	+ 1.96	+ 2.03	+ 2.13	+ 2.22				
	SP	+ 1.32	+ 2.44	+ 2.79	+ 4.62	+ 13.74*	+ 14.32*	+ 14.53*	+ 14.80*	+ 15.04*	+ 15.22*			3 +	
	FAIL	+ 0.42	+ 0.63	+ 0.73	+ 0.96	+ 0.88	+ 0.96	+ 0.97	+ 0.98	+ 1.05	+ 1.19			open	
C .48Meg	AV	+ 1.15	+ 2.07	+ 2.62	+ 3.08	+ 3.53	+ 4.19	+ 4.69	+ 5.30	+ 6.20	+ 7.03				
	SP	+ 17.58*	+ 2.82	+ 3.92	+ 4.82	+ 6.03	+ 7.16	+ 8.66	+ 11.29	+ 14.52	+ 17.45			8 +	
	FAIL	+ 0.79	+ 1.16	+ 1.45	+ 1.59	+ 1.55	+ 1.70	+ 1.72	+ 6.84	+ 1.99	+ 2.09			open	
TOTAL NO. FAILS		2+1open	1+2open	4+2open	7+2 open	9+2 open	11+2open	10+2open	11+2open	11+2open	12+2open	12+2open	12+2open	12+2open	

TABLE VII HIGH STABILITY - RELIABILITY EVALUATION SUMMARY

TEST MOISTURE RESISTANCE - WET (POLAR) SPEC. LIMIT $\pm 3.0\%$ PAGE OF

RUN NO. - RANGE		CYCLES												TOTAL NO. FAILS	
		10	20	30	40	50	60	70	80	90	100				
24Ω	AV	+ 0.79	+ 0.87	+ 0.97	+ 0.95	+ 1.02	+ 1.09	+ 1.15	+ 1.46	+ 1.74	+ 1.66				
	50%	+ 1.53	+ 1.93	+ 2.09	+ 2.14	+ 2.46	+ 2.74	+ 3.02	+ 3.14	+ 3.18	+ 3.30				
	50%	+ 0.49	+ 0.57	+ 0.61	+ 0.58	+ 0.62	+ 0.66	+ 0.69	+ 0.66	+ 1.3.27	+ 0.74				
	FAIL	0	0	1 open	1 open	1 open	1 open	1+1 open	1+1 open	2+ 1 open	2+1 open				
3000Ω	AV	- 0.44	+ 0.13	- 0.17	+ 0.35	+ 0.43	+ 0.54	+ 0.65	+ 0.78	+ 0.81	+ 0.95				
	50%	- 0.17	+ 0.51	+ 0.39	+ 3.91*	+ 2.21*	+ 6.06 *	+ 5.91 *	+ 5.94 *	+ 6.16 *	+ 7.02 *				
	50%	- 0.56	+ 0.03	- 0.33	- 0.26	- 0.21	- 0.13	- 0.10	- 0.03	0.00	+ 0.06				
	FAIL	0	0	0	1	1	1	1	1	2	2				
0.27Meg	AV	+ 1.17	+ 1.42	+ 1.60	+ 2.03	+ 1.82	+ 1.98	+ 2.10	+ 2.33	+ 2.43	+ 2.70				
	50%	+ 1.34	+ 1.60	+ 1.73	+ 4.78	+ 16.12 *	+ 8.59 *	+ 9.22 *	+ 9.65 *	+ 10.21 *	+ 11.62 *				
	50%	+ 0.97	+ 1.18	+ 1.33	+ 1.37	+ 1.48	+ 1.59	+ 1.70	+ 1.73	+ 1.81	+ 1.90				
	FAIL	1	1	1	2	3	2+1 open	1+1 open	2+1 open	2+1 open	2+1 open				
0.48Meg	AV	+ 2.06	+ 2.46	+ 3.06	+ 4.41	+ 2.86	+ 3.09	+ 2.65	+ 3.55	+ 3.71	+ 4.16				
	50%	+ 6.01	+ 6.28	+ 6.76	+ 18.19	+ 6.71	+ 6.86	+ 6.99	+ 7.07	+ 7.15	+ 7.29				
	50%	+ 1.40	+ 1.70	+ 1.84	+ 1.96	+ 1.99	+ 2.15	+ 2.49	+ 2.30	+ 2.39	+ 2.50				
	FAIL	2	3	3	3	2+1 open	3+1 open	4+1 open	5+2 open	5+1 open	5+3 open				
TOTAL No. FAILS		2	4	5	7	8	9	10	13	14	16				
R C 20															
38Ω	AV	+ 0.36	+ 0.47	+ 0.68	+ 1.03	+ 1.04	+ 1.30	+ 1.34	+ 1.39	+ 1.44	+ 1.49				
	50%	+ 0.58	+ 0.74	+ 1.25	+ 2.07	+ 2.21	+ 2.50	+ 2.53	+ 2.56	+ 2.61	+ 2.69				
	50%	+ 0.26	+ 0.32	+ 0.38	+ 0.46	+ 0.46	+ 0.49	+ 0.53	+ 0.56	+ 0.59	+ 0.61				
	FAIL	0	0	0	0	0	0	0	0	0	0				
2800Ω	AV	+ 0.31	+ 0.47	+ 0.68	+ 0.77	+ 0.81	+ 0.99	+ 1.05	+ 1.18	+ 1.35	+ 1.49				
	50%	+ 0.41	+ 0.62	+ 1.07	+ 1.22	+ 1.53	+ 1.72	+ 1.83	+ 2.21	+ 2.63	+ 2.97				
	50%	+ 0.22	+ 0.31	+ 0.41	+ 0.45	+ 0.32	+ 0.50	+ 0.51	+ 0.55	+ 0.61	+ 0.65				
	FAIL	0	0	0	0	0	0	0	0	0	0				
.24Meg	AV	+ 0.45	+ 0.65	+ 0.73	+ 0.85	+ 0.85	+ 1.00	+ 1.19	+ 1.19	+ 1.69	+ 1.91				
	50%	+ 0.55	+ 0.76	+ 0.92	+ 1.07	+ 1.16	+ 1.50	+ 1.77	+ 2.07	+ 3.46	+ 4.35				
	50%	+ 0.29	+ 0.30	- 0.01	+ 0.08	- 0.31	- 0.08	- 0.08	- 0.09	+ 0.24	+ 0.19				
	FAIL	0	0	0	0	0	0	0	0	2	2				
.48Meg	AV	+ 0.96	+ 1.27	+ 1.43	+ 1.60	+ 1.64	+ 1.84	+ 1.92	+ 2.05	+ 2.27	+ 2.92				
	50%	+ 1.15	+ 1.56	+ 1.78	+ 1.95	+ 1.99	+ 2.31	+ 2.48	+ 2.65	+ 2.92	+ 6.85				
	50%	+ 0.77	+ 1.05	+ 1.15	+ 1.31	+ 1.23	+ 1.40	+ 1.47	+ 1.56	+ 1.78	+ 1.93				
	FAIL	0	0	0	0	0	0	0	0	0	6+1 open				
TOTAL No. FAILS		0	0	0	0	0	0	0	0	0	0				

TABLE III HIGH STABILITY-RELIABILITY EVALUATION SUMMARY

Moisture Resistance, Load and Polar-Dry Spec. Limit $\pm 1.5\%$ $\pm 3.0\%$ 10,000
 TEST Reading After 100 Cycles Dielectric & Insulation Resist. PAGE OF

RUN NO. - RANGE		CYCLES										TOTAL NO. FAILS
		Load	Polar	Dielec.	Ins. Resist.							
R C 07	24Ω	AV + 0.60	+ 1.42	- 0.10								
		AV + 1.44	+ 3.26	+ 0.12								
		AV + 0.25	+ 0.70	- 1.06								
		AV 0	3+1open	2/19	0							
		AV + 0.91	+ 1.80	- 0.08								
	3000Ω	AV + 1.05	+ 7.03	+ 0.02								
		AV + 0.83	+ 0.06	- 0.11								
		AV 0	5+1open	1+1open/10 units	2							
		AV + 5.89	+ 3.85	- 0.06								
		AV + 13.55	+ 11.80	+ 0.25								
	0.27Meg	AV + 1.78	+ 1.88	- 0.65								
		AV 5+1open	2+2open	2/18	0							
		AV + 5.42	+ 4.11	- 0.24								
		AV + 13.04	+ 7.23	+ 0.10								
		AV + 2.60	+ 2.42	- 1.89								
0.48Meg		AV 8	4+3open	2/17	3							
TOTAL NO. FAILS												
R C 20	38Ω	AV + 0.75	+ 1.51	- 0.02								
		AV + 1.86	+ 2.69	+ 2.56								
		AV + 0.19	+ 0.61	- 0.08								
		AV 1	5	2/20	0							
		AV + 5.09	+ 0.76	+ 0.01								
	3000Ω	AV + 44.81	1.86	+ 0.04								
		AV + 0.55	+ 0.19	- 0.08								
		AV 6		0/20	1							
		AV + 3.70	1.33	- 0.07								
		AV + 15.26	+ 2.11	+ 0.05								
	0.24Meg	AV + 1.20	+ 0.09	- 0.08								
		AV 3+1open	2 open	0/18	0							
		AV + 7.06	+ 2.98	- 0.07								
		AV + 17.48	+ 6.84	+ 0.02								
		AV + 2.13	+ 1.95	- 1.00								
0.48Meg		AV 7+1open	3+2open	1/18	0							
TOTAL NO. FAILS												

Table XIV

Environment	Severity Ratio-A	Failure Rate Goals		Observed Failure Rates		Failure Rate Contribution
		Failure Contribution	Rate Goal	Actual Failure Rate	Upper 80% Conf-Limit=b	
Moisture	75	0.014%	1.05%	14/160=8.75%	11.31%	0.151%
Load Life	30	0.014%	0.42%	2/160=0.625%	1.34%	0.045%
Low Temp. Exp.	100	0.014%	1.40%	0/160=0.0%	1.01%	0.010%
High Temp. Exp.	100	0.014%*	1.40%	OMITTED		
Shock	500	0.014%	7.00%	0/160=0.0%	1.01%	0.002%
Vibration	500	0.014%	7.00%	0/160=0.0%	1.01%	0.002%
Acceleration	500	0.014%	7.00%	0/160=0.0%	1.01%	0.002%

0.086%*

0.212%

*Note: High Temperature Exposure Omitted.